

LAX Airport Hydrogen Fueling Station – Small Footprint H₂ Capability at the Corner Filling Station



State Energy Programs Special Projects
Category 6.53: Power Technologies
Compression, Storage, and Dispensers

Aaron S. Rachlin
Praxair, Inc.

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Objectives

- **Establish and implement a small footprint hydrogen fueling station design compatible with a retail fueling station facility**
- **Support a small fleet of hydrogen fueled vehicles, with expandability**
- **Modular and reproducible design**

Budget



- Total funding for the project: \$1.9 MM+
 - Contractors and contributors shares:
 - ◆ Praxair: \$550,000
 - ◆ U.S. DOE: \$499,048 (FY '02 – '04)
 - ◆ SCAQMD: \$351,000
 - ◆ BP: \$500,000
 - ◆ Total: \$1,900,048
 - DOE FY '04 funding: \$184,048

Technical Barriers & Targets



- MYPP Technology Validation section 3.5.4.2

- **C. Hydrogen Refueling Infrastructure**

- ◆ “Integrated facilities with footprints small enough to be deployed into established refueling infrastructures...”

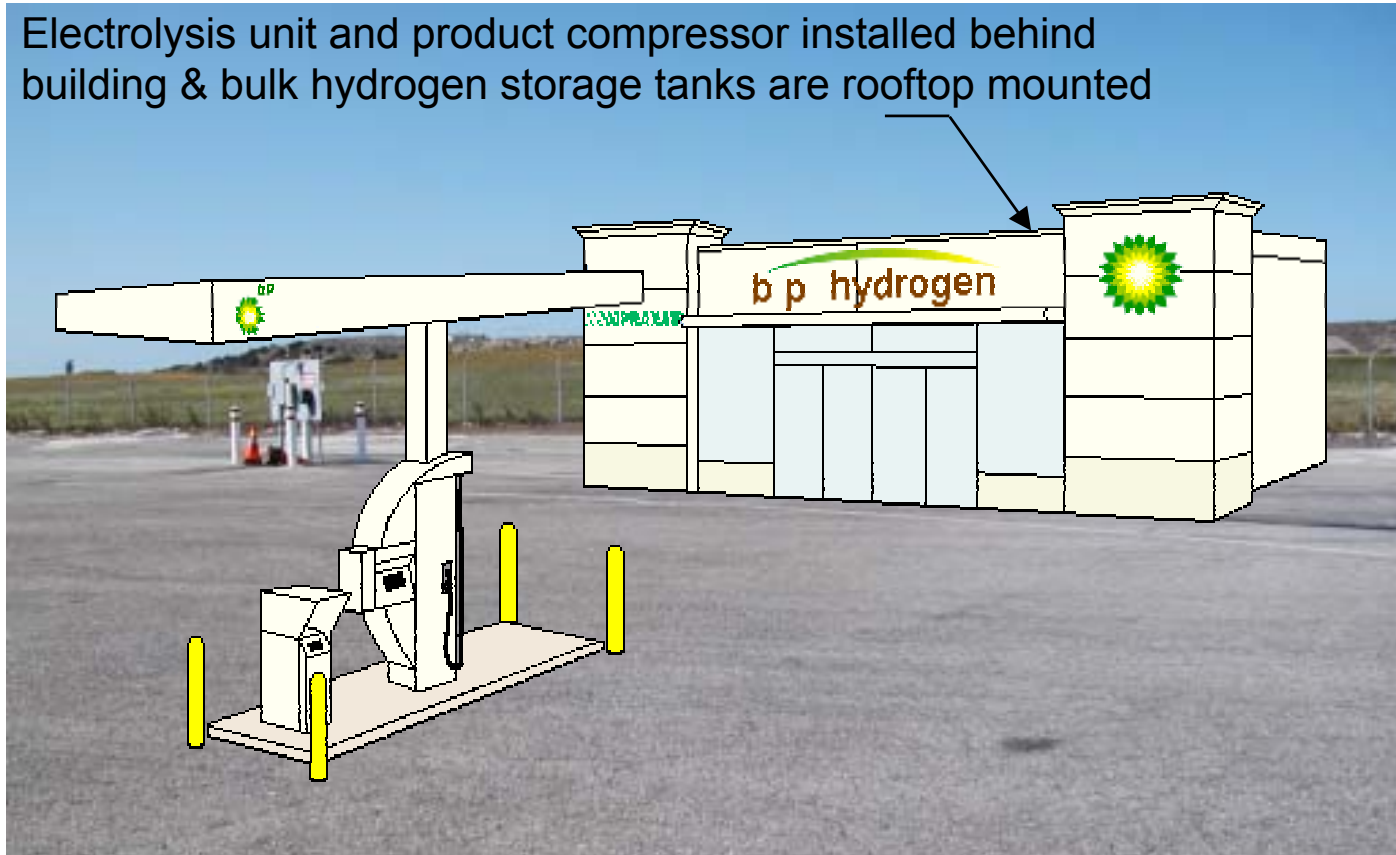
- **To satisfy above footprint requirements, the LAX hydrogen fueling station will incorporate:**

- Roof-mounted hydrogen storage
 - Low-profile H₂ equipment located behind small station building
 - Traditional fueling station canopy with CAFCP compatible dispenser

Technical Barrier Approach



Electrolysis unit and product compressor installed behind building & bulk hydrogen storage tanks are rooftop mounted



Technical Approach- (Cont.)

➤ **Electrolysis**

- 100 psig electrolyzer output to reduce compression ratios
- Minimized footprint while maintaining 4-sided access

➤ **Compression**

- Hydraulically driven reciprocating compressor
- Flexible operational modes (for future bus/HDV refueling)

➤ **Rooftop Hydrogen Storage – Small Footprint**

- Traditional ASME coded steel construction
- Cascaded bank configuration – 6,600 psig

➤ **Dispensing**

- Fast fills of cars within 5 minutes
- Designed compatible for future bus/HDV fueling

Technical Approach (Cont.)



➤ **Small Footprint Design**

- **Bulk hydrogen receiver tubes placed on roof of a prototype convenience store to greatly reduce footprint**
- **Originally desired composite storage, but Cal-OSHA regulations require ASME Steel Tanks**
- **Underground storage considered, but rejected for budgetary and safety considerations**






















➤ **Key Lessons Learned:**

- **Overall station footprint is not a function only of the size of the equipment, but of equipment positioning in a small area**
 - **Other considerations, e.g., safety and maintenance access, must also be considered when attempting to minimize footprint**

Project Safety

- **Safety is Top Priority at LAX Hydrogen Fueling Station:**
 - Safety Passport required for all construction workers/visitors
 - LEL detection at likely leak points (e.g., in electrolyzer, compressor, and dispenser cabinets, and under canopy)
 - Audible & visible alarms activated upon H₂ leak detection or other process trip
 - Shear plate for automatic switch-off of hydrogen flow if dispenser is sheared from island
 - Vehicular collision switch (bumped dispenser shuts down)
 - PET (Plant Emergency Trip) kill switches – two in rear of building, and a dispenser trip switch on fueling island
 - PIN/Safety & station usage training required in advance of vehicle fueling authorization
 - Public station, but fueling only for ‘approved’ vehicles

Project Timeline

ID		Task Name	2003				2004				2005				2006		
			Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
1		Site Selection & Characterization															
2		System Design															
3		Equipment Ordered															
4		Permit Applications															
5		Project Delay															
6		Lease Signed															
7		(Temporary) Hydrogen Available															
8		Equipment Installation															
9		Station to Open (Projected)															
10		Technology Integration/Evaluation															

Technical Accomplishments



➤ **Retail Compatible Design**

- Fine-tuning and completion of design of small footprint hydrogen based fueling infrastructure facility compatible with traditional fueling stations

➤ **Key Project Management Lessons Learned**

- Real property lease (e.g., liability & indemnification) issues best solved through education of authorities, landlords, and neighbors
- Working closely and regularly with LAFD and other Authorities with Jurisdiction (AWJs) early on in the project made permitting relatively painless

Future Work and Project Goals



- **Support a small fleet of hydrogen fueled vehicles under real world driving conditions**
 - California Fuel Cell Partnership Goal to introduce up to 60 HFCVs by 2003
 - Compatibility with other fueling stations
 - Educational/community outreach programs
- **Real world station performance to be monitored**
 - Safety
 - Performance
 - Maintenance
 - Operation
 - Cost of Delivered Hydrogen
- **Supplemental tube trailer hydrogen to be eventually introduced, pending LAX approval, if demand exceeds on-site production**

Interactions and Collaborations



➤ **Program Participants**

- Praxair - program leader/general contractor
- BP – Key Partner – station permitting and small footprint station design

➤ **Public Program Contributors**

- South Coast Air Quality Management District
- US Department of Energy (DOE)/CEC
- Los Angeles International Airport (LAX / City of LA)
 - Alternative fueled vehicle fleet operator

➤ **Station Users**

- OEMs that will be refueling their vehicles at LAX, and/or placing fleet hydrogen powered vehicles in locations proximal to the LAX H₂ Station

Responses to Previous Year Reviewers' Comments

- **Q1: Relevance to overall DOE objectives**
 - Small H₂ stations are needed
 - Good demonstration platform for electrolysis with higher pressure H₂ output than other CA stations
 - Lessons learned on permitting – meet with and inform AWJs early & often
 - Metrics & cost for delivered hydrogen will be monitored
- **Q2: Approach to performing the R & D**
 - Footprint considerations critical to commercialization
 - Economics of H₂ - \$/mi. equivalent to gasoline?
 - Utilization of ASME storage

Responses to Previous Year Reviewers' Comments (cont.)

- **Q3: Technical accomplishments and progress toward project and DOE goals**
 - Noted last year that we had good progress and an ambitious schedule...
 - Project will assist LAX and local fleet operators by making fuel available for H₂ vehicles
- **Q4: Technology transfer/collaborations with industry, universities, and other laboratories**
 - BP not only advisor, but key partner in design/project
 - Educating LAFD permitting officials and other AWJs

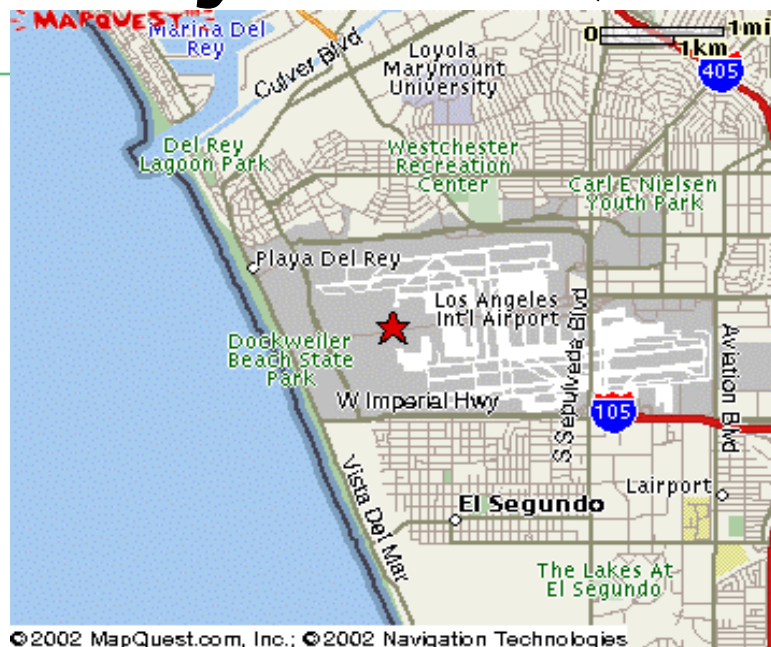
Responses to Previous Year Reviewers' Comments (cont.)

- **Q5: Approach to and relevance of proposed future research**
 - Cornerstone southern California station in CA's recently announced Hydrogen Highways program
 - Continued operation after 2 years? Will hope to continue operations for many years to come, with possible expansion as H₂ fuel demand builds. Dependent on funding
 - After station is in operation, will compare costs to similar small-scale distributed generation technologies (e.g., SMR)
- **Specific recommendation from last year:**
 - Find auto manufacturer that will lease fuel cell cars at the airport... Effort is presently under negotiation

Future Plans

- **Systems Integration of Electrolysis Unit, Compressor, Rooftop Mounted Bulk Hydrogen Storage, & High Pressure Hydrogen Dispensing to Enable Safe, & User Friendly 5,000 psig Hydrogen Refueling for Hydrogen Powered Vehicles in a Public Setting**
- **Build Station in a Safe and Timely Manner once Final Permitting and Airport Construction Approval Has Been Obtained**
- **Coordinate West Los Angeles Light Duty Fleet Hydrogen Vehicle Placement that Will Utilize the LAX Hydrogen Fueling Station**
- **Develop Relationships with Key Heavier Duty (e.g., bus, truck, and airfield operations) Vehicles**
- **Consider Use of “Green Electricity” in On-Site Hydrogen Production**

Station Location & Representative Early User - Questions?



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